The Examiner argues that

> Huang teaches the same processing steps as instantly claimed. As outlined below, Huang teaches forming a first ceramic barrier layer on the substrate, whereby a portion of the second surface of the first ceramic barrier layer is modified via plasma treatment (i.e. introducing nucleation sites on the second surface of the first ceramic barrier layer; see instant application, pg. 4, lines 1-5). Then, a second ceramic barrier is deposited directly on the second surface of the first ceramic barrier layer. Since Huang teaches substantially the same processing steps utilizing substantially the same materials as claimed, it is axiomatic that one who performs the steps of a process must necessarily produce all of its advantages and the mere recitation of a newly discovered property that is inherently possessed by the steps in the prior art does not cause a claim drawn to those steps to distinguish over the prior art.

(office action, pages 2-3)

Huang describes "a first plasma treatment 125 is carried out in order to *remove* impurities such as carbon, oxides which are inherently present . . . consequently the first refractory metal nitride layer 112 is transformed into a thinner first metal nitride barrier layer 114 . . . . The first plasma treatment 125 comprises preferably a plasma gas containing nitrogen and hydrogen" (paragraph 28, emphasis added). A person of skill in the art knows that plasma can be used in a number of different semiconductor device fabrication processes, including etching (see paragraph 27 of Huang "the mask 106 is removed . . . the removal process is preferably a dry etch process using an oxygen plasma . . ."), and more specifically reactive ion etching (see paragraph 26 of Huang "The etch process . . . may, for example, be performed by reactive ion etching (RIE) by using a suitable plasma gas"), implantation (see paragraph 6 of Huang, "One approach is to implant nitrogen into TiN . . . . One method for implanting the nitrogen into TiN is to perform a nitrogen plasma treatment.") and deposition, such as Plasma Enhanced Chemical Vapor Deposition (a plasma enhanced version of the CVD process described by Huang in

paragraph 32). Therefore, there are plasma processes that *remove* ions from the surface of a material, while others *add* ions to the surface. These plasma processes are not considered to be equivalents. Not all plasma processes achieve the same effect and certainly cannot be found to inherently produce the same results.

The Examiner interprets Huang's plasma treatment as inherently having the same effect as introducing new nucleation sites on a surface. However, inherency requires that the missing descriptive material is "necessarily present," not merely probably or possibly present, in the prior art (Trintec Industries, Inc. v. Top-U.S.A. Corp., 295 F.3d 1292, 1295 (Fed. Cir. 2002). Huang's plasma treatment does not *necessarily* introduce new nucleation sites on a surface. Rather, Huang's plasma treatment *removes* components from a surface. Thus, Huang's plasma treatment of a layer to remove impurities does not inherently anticipate the limitation of "modifying at least a portion of the second surface of the first ceramic barrier layer to introduce first nucleation sites on the second surface", which is required by claim 1.

B. Huang fails to describe barrier layers with enhanced barrier capabilities against gas and liquid.

The Examiner argues that Huang's barrier layers "inherently . . . . together have enhanced barrier capabilities against gas and liquid as compared to similar adjacent ceramic barrier layers formed without the (plasma treatment) step" (page 4). As noted above, the plasma treatment in Huang is not the claimed modification step. Further, Huang's barrier layers do not address the migration of gas and liquid. Rather, Huang describes a problem of metal ion migration through cracks that result when a tungsten layer is formed on a metal nitride barrier layer that has been thermally processed in order to reduce contact resistance (see paragraph 8). Huang also discloses a plasma treatment that changes the zeta potential of the barrier layer to be different from the zeta potential of the tungsten layer (paragraph 32). This allows the tungsten to adhere to the barrier layer, thereby preventing cracking of the barrier layer.

Huang improves the barrier properties of the barrier layers by using two barrier layers instead of one, because a single layer is too thin after the plasma gas treatment (paragraph 7).

Huang also eliminates defects by improving the adhesion between the *tungsten contact* and the barrier layer (paragraph 16). Huang does not identify a problem of void or cracks in the device before the tungsten contact is formed. Huang only notes that too thin of a barrier layer is problematic for metal migration, not that sufficient barrier layers themselves have a problem of allowing metals to pass through.

A plasma treatment is carried out to prevent migration through the layers, but it is migration of metal ions that the plasma treatment prevents. Specifically, the plasma treatment is carried out to remove impurities and to increase the nitrogen content of the barrier layer to prevent aluminum and tungsten from migrating through the layer (paragraph 6). The treatment does not inherently provide the barrier layers with enhanced barrier capabilities against *gas and liquid*, which have different properties than metal ions, as claimed in claim 1.

C. Huang fails to disclose forming a second barrier layer that is initiated at nucleation sites.

As noted herein, Huang describes treating a metal nitride layer to *remove* impurities in the upper part of the layer. However, there is no introduction of nucleation sites. Thus, Huang does not "form a second ceramic barrier layer . . . wherein the second barrier layer is initiated at the first nucleation sites" which are on the first ceramic barrier.

Further, Huang is directed to preventing metal atoms or ions from traveling along cracks that can form, as described above. Huang does not produce nucleation sites. Thus, dislocations present in a first layer formed corresponding to Huang's process will tend to be reproduced in the second layer (if the layers are ceramic layers). Huang is concerned about the migration of metal atoms or ions, which tend to be larger than liquid or gas molecules, and Huang may not be concerned about migration along matching adjacent layer's dislocations. The mechanism for migration of metal ions or atoms can be quite different from those of gas or liquid molecules. Finally, Huang does not suggest performing a treatment of a layer to introduce a nucleation site, such that a second layer can be initiated at the nucleation site and the second layer is formed without continuing all defects of the first layer.

For at least the foregoing reasons, Huang fails to anticipate claim 1 as pending.

Claims 1-3, 6, 7, 10-15 and 17-26

Claims 1-3, 6, 7, 10-15 and 17-26 were rejected as anticipated by U.S. Publication No. 2003/0203210 ("Graff '210"). The applicant respectfully disagrees.

Graff '210 fails to teach modifying at least a portion of the second surface of the first ceramic barrier layer to introduce first nucleation sites on the second surface. The Examiner argues that Graff '210 teaches "[a] portion of the second surface of the first ceramic barrier layer is modified to introduce nucleation sites on the second surface via plasma treatment." (office action, page 4) Applicant respectfully disagrees.

Graff '210 teaches plasma-treating a foundation barrier layer 22, which can remove contaminants, dehydrate and modify the effective surface area and density of the treated surface, (paragraph 73). As noted above, there are a variety of plasma treatment types. In addition, using different gases with different plasma treatments can provide different results. For example, Graff '210 notes that there are generally two categories of plasma treatment available, at least with respect to treating polymer films (paragraph 65). A chemically inert working gas, typically argon, limits modification and/or introduction of functional groups to species originating with the chemistry of the surface treated. Use of a reactive gas provides the potential for more significant modification of the surface treated. E.g., using a nitrogen gas in a plasma gas to treat a polyester substrate can result in amines, amides and other nitrogen-based compounds on the surface of the substrate. Graff '210 explains that plasma-treatment of the inorganic layers removes surface contaminants, thus the adjacent organic layers 24 and 34 are generally subject to little contamination from migratory organic species that might otherwise be present on the surfaces of the barrier layers 22 and 32 (paragraph 83).

Graff '210 fails to describe what type of reaction conditions are being used when plasma treating the inorganic layer. Graff '210 only describes removing contaminants, dehydrating and modifying the effective surface area and density of the treated surface. Specifically, Graff '210

teaches that the applied plasma process is selected in order to *remove* organic species, not to *introduce* nucleation sites. The nucleation sites on the first ceramic barrier layer in claim 1 provide initiation sites for a second ceramic barrier layer. The nucleation sites allow for the second ceramic barrier layer to be formed so that not all defects of the first ceramic barrier layer are continued. Graff '210 does not disclose modifying a layer *to introduce nucleation sites on the surface*, as required by claim 1. For at least this reason, claim 1 and the claims that depend therefrom are not anticipated by Graff '210.

Section 103 Rejections

Claim 27 is rejected as being unpatentable over Graff '210 in further view of U.S. Patent No. 6,522,067 ("Graff '067"). Claim 27 depends from claim 1.

Both Graff '210 and Graff '067 fail to disclose modifying a layer to introduce nucleation sites on the surface, as required by claim 1. For at least this reason, claim 27, which depends from claim 1, is not obvious over Graff '210 in view of Graff '067.

The one-month extension of time fee in the amount of $130 is being paid concurrently herewith on the Electronic Filing System (EFS) by way of Deposit Account authorization. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: September 25, 2009

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